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Kumar et al.

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(54) **WIRELESS ROUTERS UNDER TEST**

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H04W 84/12 (2009.01)

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CPC ***H04L 43/50*** (2013.01); ***H04L 43/12*** (2013.01); *H04L 43/14* (2013.01); *H04W 84/12* (2013.01)

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See application file for complete search history.

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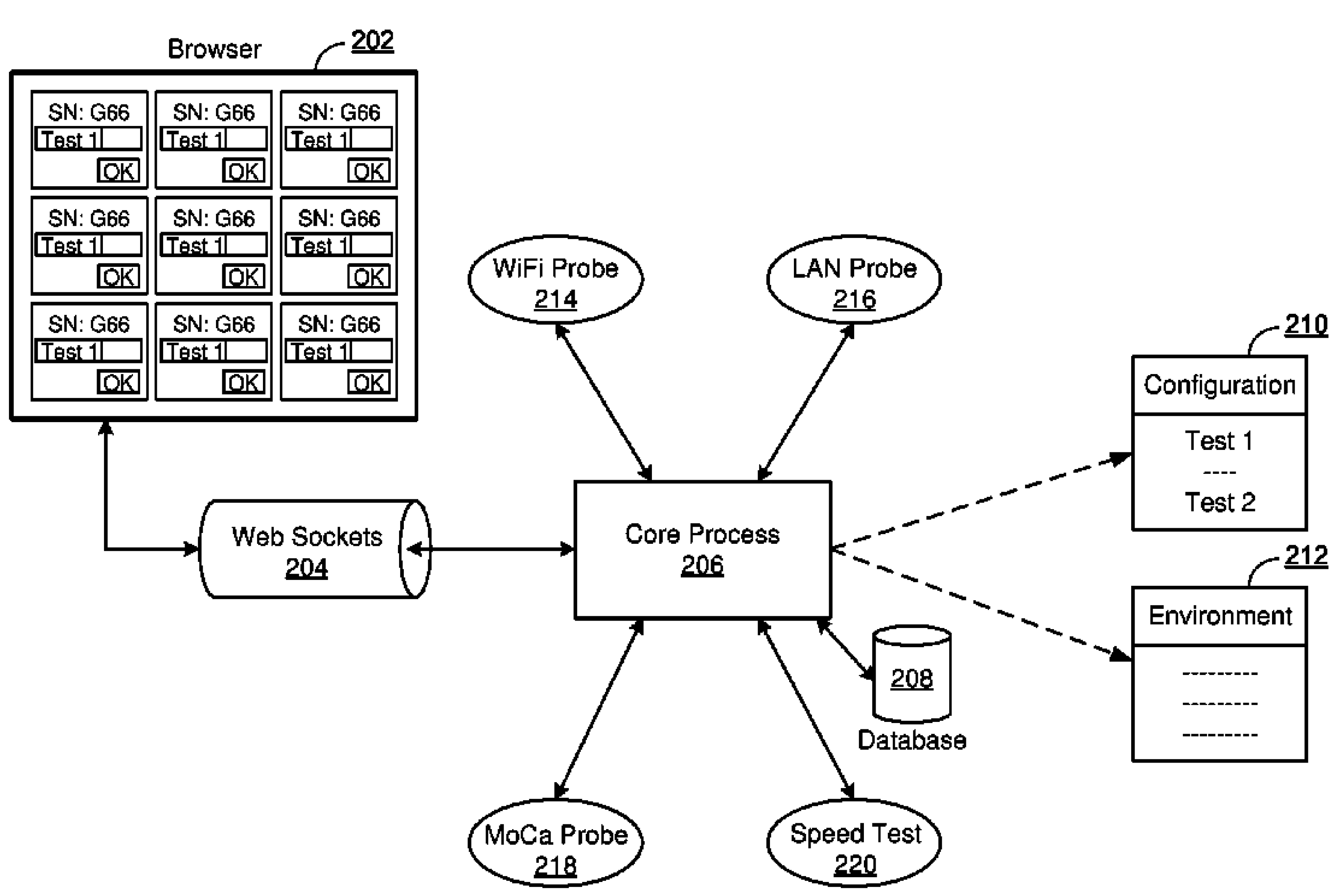
(57) **ABSTRACT**

A system for testing multiple wireless routers independently and simultaneously using different types of device probes is disclosed. The system includes real-time, bi-directional/asynchronous communication and interaction between system components.

19 Claims, 4 Drawing Sheets



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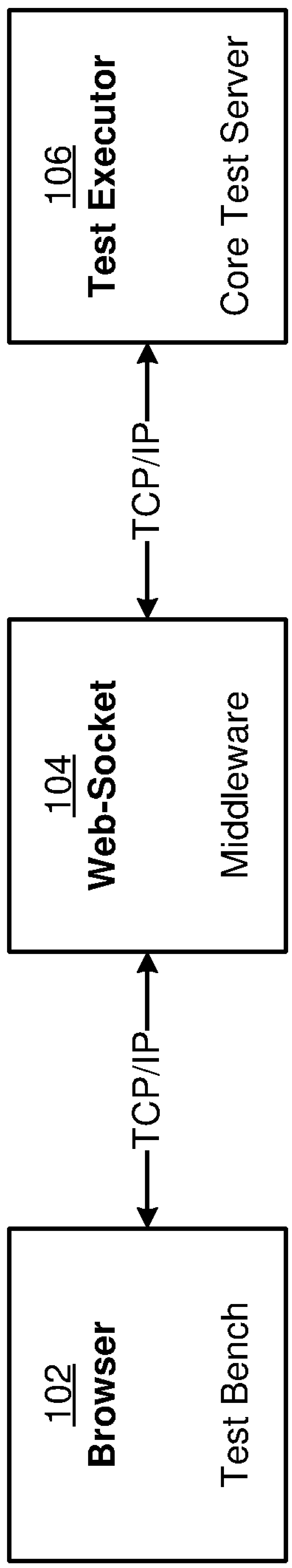
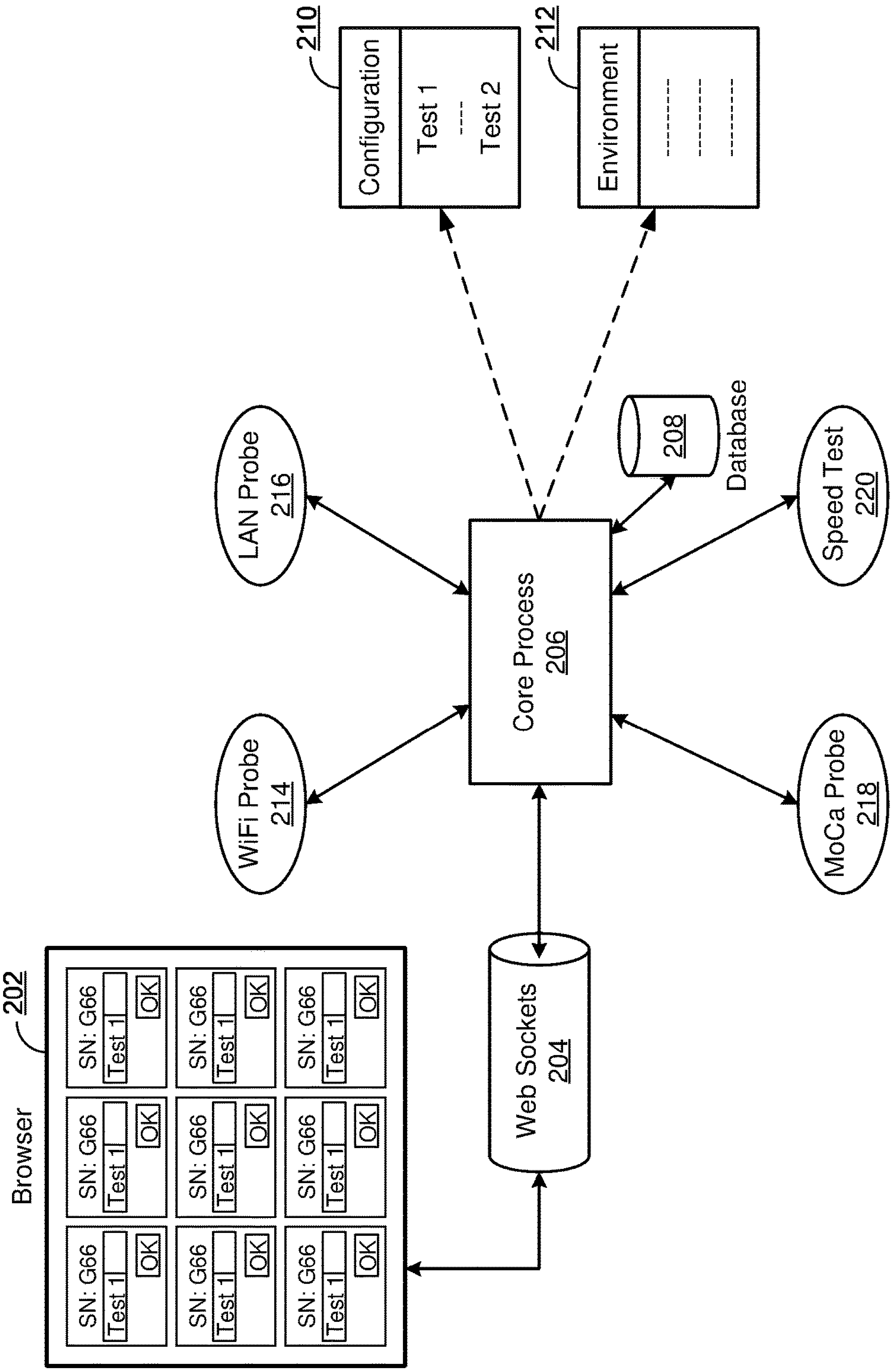
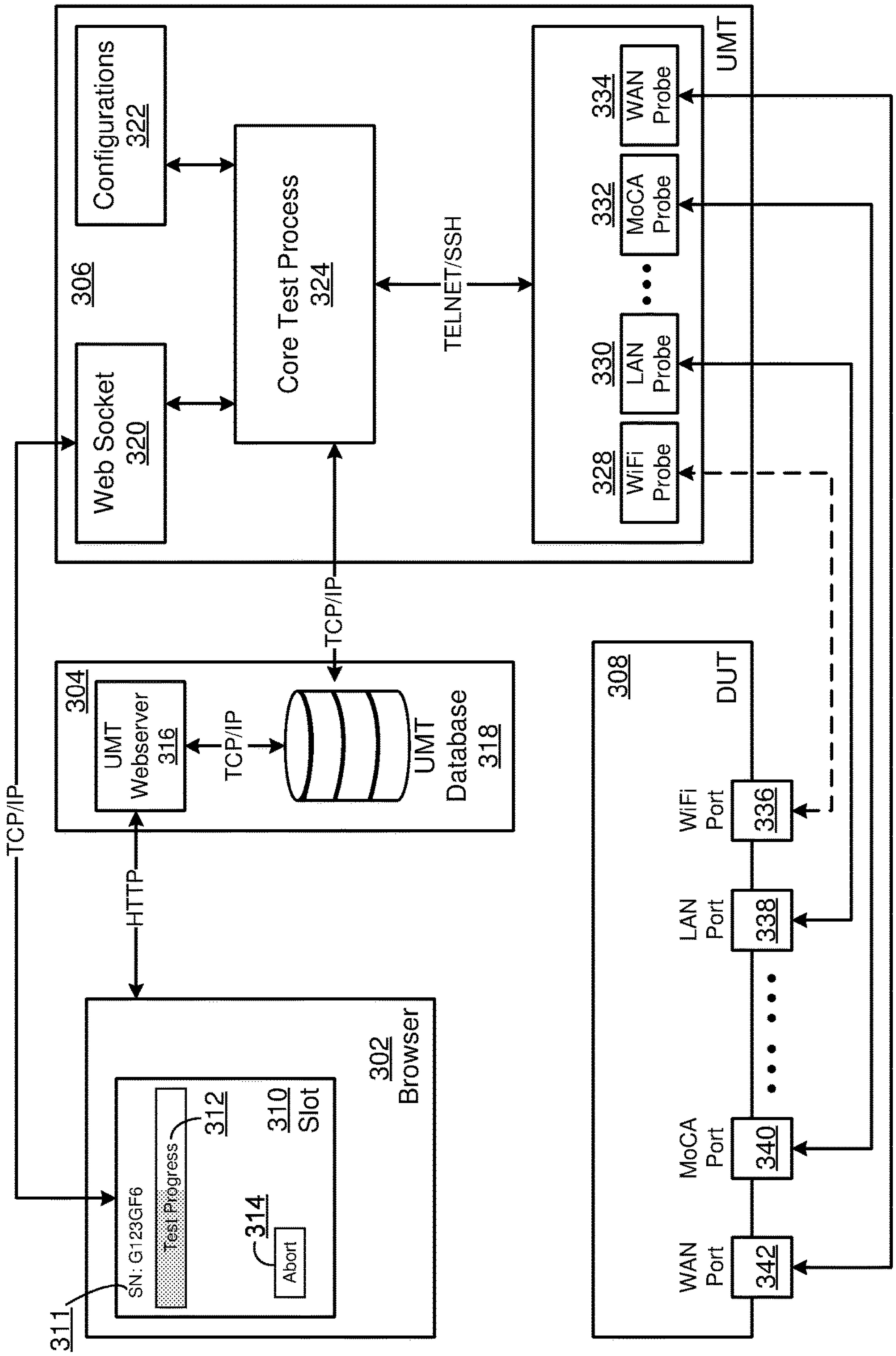

102
Browser
Test Bench
TCP/IP
104
Web-Socket
Middleware
TCP/IP
106
Test Executor
Core Test Server

FIG. 1


210
Configuration
Test 1

Test 2
212
Environment
LAN Probe
216
208
Database
Speed Test
220
Core Process
206
WiFi Probe
214
MoCa Probe
218
202
Browser
SN: G66
Test 1
OK
Web Sockets
204

FIG. 2



306
Web Socket
320
Configurations
322
Core Test Process
324
TELNET/SSH
UMT
328
WiFi Probe
330
LAN Probe
332
MoCA Probe
334
WAN Probe
TCP/IP
304
UMT Webserver
316
TCP/IP
UMT Database
318
HTTP
TCP/IP
302
Browser
310
Slot
311
SN: G123GF6
312
Test Progress
314
Abort
308
DUT
WiFi Port
336
LAN Port
338
MoCA Port
340
WAN Port
342

FIG. 3

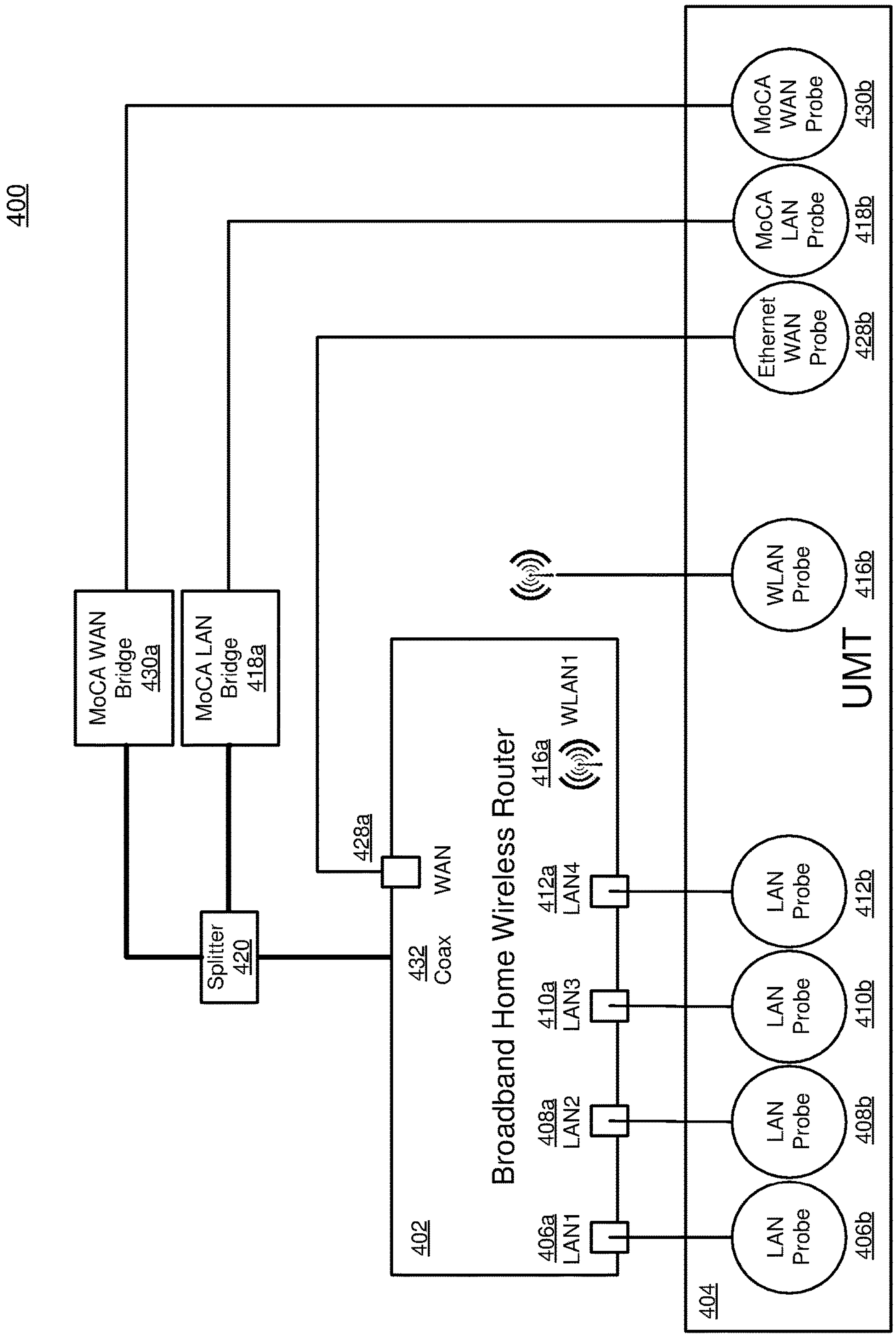

400
MoCA WAN Bridge 430a
MoCA LAN Bridge 418a
Splitter 420
432 Coax
428a
WAN
402
Broadband Home Wireless Router
406a LAN1
408a LAN2
410a LAN3
412a LAN4
416a
WLAN1
404
LAN Probe 406b
LAN Probe 408b
LAN Probe 410b
LAN Probe 412b
WLAN Probe 416b
Ethernet WAN Probe 428b
MoCA LAN Probe 418b
MoCA WAN Probe 430b
UMT

FIG. 4

WIRELESS ROUTERS UNDER TEST

CROSS REFERENCE

This application is a continuation of U.S. patent application Ser. No. 14/948,925, filed Nov. 23, 2015, now a U.S. Pat. No. 9,838,295, issued on Dec. 5, 2017, which is hereby incorporated by reference in its entirety.

This application is also related to U.S. patent application Ser. No. 14/866,720 filed Sep. 25, 2015, now a U.S. Pat. No. 9,810,735, issued on Nov. 17, 2017, and to U.S. patent application Ser. No. 14/866,752 filed Sep. 25, 2015, and to U.S. patent application Ser. No. 14/866,630 filed Sep. 25, 2015, now a U.S. Pat. No. 9,960,989, issued on May, 1, 2018, and to U.S. patent application Ser. No 14/866,780 filed Sep. 25, 2015, now a U.S. Pat. No. 9,491,454, issued on Nov. 8, 2016, and to U.S. patent application Ser. No. 14/948,143 filed Nov. 20, 2015, now a U.S. Pat. No. 9,992,084, issued on Jun. 05, 2018, and to U.S. patent application Ser. No. 14/929,180 filed Oct. 30, 2015, and to U.S. patent application Ser. No. 14/929,220 filed Oct. 30, 2015, each of which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

The present invention is directed to a system for testing devices.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the aforementioned aspects of the invention as well as additional aspects and embodiments thereof, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

FIG. **1** illustrates a high-level system architecture for testing devices, according to certain embodiments.

FIG. **2** illustrates some of the testing components and the interaction between the testing components, according to certain embodiments.

FIG. **3** illustrates a sample architecture that includes the testing components, according to certain embodiments.

FIG. **4** illustrates a wireless router under test, according to certain embodiments.

DETAILED DESCRIPTION

Methods, systems, user interfaces, and other aspects of the invention are described. Reference will be made to certain embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the embodiments, it will be understood that it is not intended to limit the invention to these particular embodiments alone. On the contrary, the invention is intended to cover alternatives, modifications and equivalents that are within the spirit and scope of the invention. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

Moreover, in the following description, numerous specific details are set forth to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these particular details. In other instances, methods, procedures, components, and networks that are well known

to those of ordinary skill in the art are not described in detail to avoid obscuring aspects of the present invention.

According to certain embodiments, an innovative system can test a set of devices simultaneously. Further, such a testing system is capable of testing disparate devices simultaneously.

According to certain embodiments, such a testing system provides a separate set of interfaces for each device that is under testing of the set of devices. Further, such a system is designed to be adaptive by being extendable for testing new devices with corresponding new testing interfaces without fundamentally changing the core architecture of the testing system. As a non-limiting example, the testing system includes a core testing subsystem with a user interface and asynchronous communication among the system components such that new types of devices and new tests can be added and executed in a seamless fashion.

According to certain embodiments, the user interface can communicate through web sockets with a universal tester. Such communication is in real-time, bi-directional and asynchronous so that the user can control and monitor the testing of multiple devices simultaneously and independently of each other using the same universal tester and associated test bench.

According to certain embodiments, the testing system is capable of testing a set of similar types of devices or a set of disparate devices.

According to certain embodiments, a testing solution system can be a three layer implementation. The number of layers may vary from implementation to implementation. FIG. **1** illustrates a high-level system architecture for testing devices, according to certain embodiments. FIG. **1** shows a test bench browser interface **102** that is in communication with a web-socket **104**, that is, in turn, in communication with a core testing processor **106**. According to certain embodiments, the communication between the test bench browser **102**, web-socket **104** and core testing processor **106** can be a TCP/IP communication. As a non-limiting example, the web browser is used as a user interface that communicates through web-sockets with the core testing processor. As a non-limiting example, communication may be in the form of JSON messages using TCP/IP protocol, according to certain embodiments. JSON is Java script object notation for transmitting data between the server and web applications.

FIG. **2** illustrates some of the testing components and the interaction between the testing components, according to certain embodiments. FIG. **2** shows a user interface **202**, web-sockets **204**, a core testing processor **206**, database **208**, test configuration modules **210**, testing environment modules **212**, a plurality of probes (**214**, **216**, **218**) to connect the devices under test (DUT) to the core testing processor **206**, and a speed test module **220**, according to certain embodiments. Speed testing is used for evaluating the performance of the WiFi and other media network connection and accessibility of the device under test. FIG. **2** shows as non-limiting examples, a WiFi probe **214**, an Ethernet local area network (LAN) probe **216** and a MOCA probe **218**. In other words, according to certain embodiments, various probes can be included such as a wireless local area network (WLAN) probe, an Ethernet wide area network (WAN) probe, a multimedia over coax alliance (MoCA) WAN probe, a MoCA LAN probe and a wireless probe via antenna. According to certain embodiments, servers and other components in the testing system may be distributed over a plurality of computers.

According to certain embodiments, core testing processor **206** loads and reads files from test configuration modules

210 and test environment modules 212 to initialize various components of the testing system. When the system is ready to begin testing after the initialization process, the system notifies a user that is using the testing system to test one or more devices (DUTs) of the readiness of the testing system. The user installs each device or DUT (of the set of DUTs that are to be tested) in a separate Faraday cage (slot) in the test bench and the serial number of each DUT is scanned. According to certain embodiments, there are several Faraday cages (slots) in a given test bench so that a plurality of DUTs can be tested simultaneously using the same test bench and same universal tester. The core testing processor **206** receives the serial number information of each DUT and using the serial number, retrieves further information associated with each DUT based on the serial number from database **208**, according to certain embodiments. The core testing processor **206** dynamically loads test configuration information **210** and test environment information **212** based on device information such as make, model etc of a given DUT. After the test configuration and test environment information are loaded, the core testing processor **206** begins executing the various tests corresponding to each DUT so that the set of DUTs can be tested simultaneously. Each test may correspond to underlying testing modules associated with WiFi, LAN, WAN or MoCA etc, interfaces of the DUT and such modules can be executed locally, remotely or at the device.

According to certain embodiments, the test configuration information identifies the test modules and corresponding testing scripts that are to be executed by the core testing processor **206** at run time. The core testing processor **206** also provides the test results and other feedback information to the user via the browser user interface **202** and web sockets **204**. Further, the user can send user input and requests to the system through the browser user interface **202** and web sockets **204**.

According to certain embodiments, core testing processor **206** determines the success or failure of a given test based on the test configuration parameters and output results of the testing. Further, upon failure of a given test, core testing processor **206** may continue further testing or halt test execution based on test configuration parameters, according to certain embodiments.

Upon completion of the relevant tests, a success message can be sent to the user via the browser user interface **202** and web sockets **204**. Even though the DUTs in the set of DUTs are tested simultaneously, the user does not have to wait until all the testing of the DUTs in the set have been completed to begin installing other devices that need testing. Further, the testing of the devices need not be started at the same time. Soon after the testing is completed for a given DUT, the tested DUT may be uninstalled from its slot (Faraday cage) in the test bench and a new DUT can be installed in its slot so that testing can begin for the newly installed device.

According to certain embodiments, the test results can be stored locally and/or pushed to the cloud so that the results can be viewed remotely from any location. Further, the test results can be aggregated. According to certain embodiments, aggregated data includes data combined from several data measurements. Summary reports can be generated from such aggregated data. Non-limiting examples of summary reports include charts and graphs that display information on all the DUTs or at least a subset of the DUTs. Thus, the summary reports generated from the aggregated data can provide an overview of the testing information and characteristics of the DUTs. The aggregated data can reveal trends and other related information associated with the DUTs. Further, the aggregated data can include user-level data, access account activity, etc. According to certain embodiments, the testing system includes a billing system to charge for the testing services for each device.

FIG. **3** illustrates a sample architecture that includes the testing components of a universal tester, according to certain embodiments. FIG. **3** shows a browser user interface or operator dashboard **302**, a test controller **304**, a universal tester **306** and a device under test (DUT) **308**. There may be multiple devices under testing simultaneously but only one device under test is shown for convenience in FIG. **3**.

According to certain embodiments, browser user interface or operator dashboard **302** may include information **310** associated with each device under test. The information **310** can include DUT serial number **311**, and testing progress information **312**. Browser user interface or operator dashboard **302** may also include user command function buttons **314** and drop down menus (not shown in FIG. **3**). According to certain embodiments, the user can configure slot details (e.g., port numbers, IP address for the slot, etc), configure testing preferences such as push to cloud, export to billing, etc.

According to certain embodiments, test controller **304** may include a universal tester webserver **316** that is in communication (e.g., TCP/IP) with a universal tester database **318**. A billing process within the controller (not shown in FIG. **3**) may be in communication with a billing service or application (not shown in FIG. **3**). As a non-limiting example, database **318** can be a SQL database. Database **318** can store information associated with each slot in the test bench. As non-limiting examples, database **318** can store for each slot, test details, test history, test logs, DUT information (e.g., DUT serial number, model name, etc), testing preferences/configuration, user interface details/preferences/configuration, billing information, cloud push information, MSO/customer information (media subscriber organization), OEM (original equipment manufacturer) information, slot information, user information, and any persistent data needed by the universal device testing system for running tests.

According to certain embodiments, universal tester **306** may include web sockets **320** that are in communication (e.g., TCP/IP) with browser user interface or operator dashboard **302** and core testing processor **324**. According to certain embodiments, core testing processor **324** is in communication with test controller **304** (e.g., TCP/IP) and in communication (e.g., Telnet/SSH secure shell) with probes/containers (**328**, **330**, . . . , **332**, **334**). Core testing processor **324** is also in communication with configuration modules **322** (e.g., testing and environment configuration). Non-limiting examples of probes include WiFi probe **328**, LAN probe **330**, MoCA probe **332** and WAN probe **334**. There may be other types of probes including MoCA WAN probe, MoCA LAN probe and different types of wireless probes besides WiFi probes depending on the characteristics of the device being tested.

According to certain embodiments, WiFi probe **328**, LAN probe **330**, MoCA probe **332** and WAN probe **334** communicate with the respective device under test through the relevant ports on the device such as WiFi port **336**, LAN port **338**, MoCA port **340** and WAN port **342**. Core testing processor **324** executes the relevant configured tests for the respective DUT. Status and test results can be sent to the user's dashboard (using JSON format messages as a non-limiting example) via the web-sockets.

Non-limiting examples of devices under test (DUTs) include set top boxes, cable modems, embedded multimedia terminal adapters, and wireless routers including broadband wireless routers for the home or for commercial networks.

FIG. **4** illustrates a testing architecture **400** for a wireless router under test, according to certain embodiments. As previously explained, multiple similar or disparate devices can be tested simultaneously and independently of each other using the same universal tester. Thus, multiple wireless routers can be tested simultaneously and independently of each other using the same universal tester, along with other types of devices using the same universal tester. For purposes of simplicity only one wireless router is shown in FIG. **4**. FIG. **4** shows a universal tester **404** and a wireless router **402**, which is the device under test for this specific case. Non-limiting examples of wireless routers include broadband wireless routers for the home or for commercial networks. Universal tester **404** includes a plurality of virtualization containers (probes) for communicating with corresponding interfaces of wireless router **402**. For example, the core testing processor of the universal tester (as described herein) uses the LAN probes/containers **406***b*, **408***b*, **410***b*, **412***b* to test corresponding LAN interfaces **406***a*, **408***a*, **410***a*, **412***a* of wireless router **402**. WLAN (wireless LAN) probe/container **416***b* can be used to test WLAN interface **416***a* of wireless router **402**. Ethernet WAN probe/container **428***b* can be used to test WAN interface **428***a* of wireless router **402**. MoCA LAN probe/container **418***b* can be used to test Coax interface **432** of wireless router **402** via MoCA LAN bridge **418***a* and splitter **420**. MoCA WAN probe/container **430***b* can be used to test Coax interface **432** of wireless router **402** via MoCA WAN bridge **430***a* and splitter **420**. The associated core testing processor executes the relevant configured tests for the wireless router **402**. Status and test results can be sent to the user's dashboard (using JSON format messages as a non-limiting example) via the web-sockets.

According to certain embodiments, when executing a specific test for a given DUT, the core testing processor loads and reads test configuration information (for example from an XML structure) and identifies the relevant test script that needs to be executed. Inputs that are needed for executing the relevant test script are retrieved and supplied as inputs to the relevant test script. The following is a non-limiting sample test procedure.

- Create DUT object & Environment Object
- Verify Serial Number
- Verify Warranty
- Check Report Server
- Check DUT Staging
  - Checks for DUT Serial number in Database or Web-service
- Get DUT Readiness Information
  - Checks Web-service for test readiness status of DUT in the test process
- Configure Container Environment
- Clear Environment Temp Files
- Analyze DUT for Factory Reset
  - Checks ability to login to DUT
  - Asks operator to manually Factory Reset if unable to login
- Confirm Factory Reset (if needed)
  - Waits for operator to confirm that DUT was factory reset and booted up properly
- Check Ethernet LAN connections to DUT
  - Ping connections: Eth LAN **1**, **2**, **3**, **4**
  - Fails if any ping to these connections fail
- Detect DUT
  - Checks connection to DUT through socket connection
- Reset Password
  - Operator scans password which is stored temporarily for use in the remainder of test until finished
- Login to GUI
  - Done through web-scraping
- Get DUT Information and compare values
  - Information retrieved through web-scraping
- Enable Telnet
  - Enables telnet on DUT through web-scraping
- Factory Reset
  - Factory resets DUT through telnet command
- Enable Telnet after Factory Reset
  - Enables telnet on DUT through web-scraping
- Confirm Power, WAN Ethernet, and Internet LEDs
- Confirm all LAN Ethernet LEDs
- Confirm WiFi LED
- Configure Wireless Network
  - Through telnet commands
  - Sets N Mode
  - Enables Privacy
  - Sets WPA (Wi-Fi Protected Access)
  - Removes WEP (Wired Equivalent Privacy)
  - Assigns WiFi Channel to DUT (channel different by slot)
  - [Channel **1**: slots **1**, **4**, **7**, **10**, **13**, **16**]
  - [Channel **6**: slots **2**, **5**, **8**, **11**, **14**]
  - [Channel **11**: slots **3**, **6**, **9**, **12**, **15**]
  - Verifies changes through GUI
  - Disables WiFi once done through telnet
- Check Firmware Version and Upgrade Firmware (if needed)
  - Firmware version varies by models
- Cage Closed Confirmation Check
  - Asks Operator to Close Door on Cage
- Connect Wireless Card
  - Waits on shared Resource Server (located on TC) for Resource L**2** (Layer **2**) Lock
    - Lock waiting timeout: 600 sec
    - All L**2** Locks are able to run in parallel but not when any L**3** (Layer **3**) Lock is running
  - Obtains Lock
  - Enables WiFi through telnet
  - Set WiFi Card
    - Total Retries allowed: 6 (2 sets of 3 retries)
  - Ping WiFi from DUT
  - L**2** ARP Test on WiFi: must receive 10/10 ARP packets
    - Total Retries allowed: 6 (2 sets of 3 retries)
  - If either Set WiFi Card or L**2** ARP Test Fail after its 3 retries, Ask Operator to Check Antennas
  - Performs one more retry in full (set of 3 retries each for Set WiFi Card and L**2** ARP WiFi Test) after Check Antennas
  - Disables WiFi through telnet
  - Releases Lock
- Wireless to LAN Ethernet Speed Test
  - Waits on shared Resource Server (located on TC) for Resource L**3** Lock
    - Lock waiting timeout: 1800 sec
    - L**3** Locks must be run one at a time and when no L**2** Lock is running
  - Obtains Lock
  - Enables WiFi through telnet
  - Connects WiFi Card
  - Iperf3 Speed Test, 5 seconds for UDP Speed Test, 7 seconds for TCP Speed Test, Sending 200 Mbps Bandwidth

Bandwidth must be greater than 60 Mbps on TCP (Reverse) or 70 Mbps on UDP (Forward)

If Fail after 2 retries, ask operator to Check Antennas

Retries up to 2 times more if still Fail

Therefore, Total Retries allowed: 4 (2 sets of 2 retries)

Runs sudo iwlist wlan0 scan and returns all Wireless Signals seen

Results parsed to print all visible SSI Ds and its matching Signal level

Disables WiFi through telnet

Releases Lock

Check wireless signal strength

Confirm if signal strength for each antenna is greater than threshold (e.g., −50 dB)

Confirm WPS LED

Confirm LAN Coax LED

Confirm USB 1+2 LEDs

Configure WAN MoCA

Confirm WAN Coax LED

Ping WAN MoCA

Verify WPS trigger

Confirm if WPS state toggles on the DUT after instruction

L**2** Test on LAN Ethernet

Arp Test from Eth LAN **1** to Eth LAN **2**, **3**, **4**

Must receive 10/10 on all LAN connections

LAN Ethernet to LAN Ethernet Speed Test

From Eth LAN **1** to Eth LAN **2**, **3**, **4**

Iperf3 Speed Test, 5 seconds Reverse and Forward, (e.g., Sending 1200 Mbps Bandwidth)

Bandwidth must be greater than threshold (e.g., 700 Mbps)

Total Retries allowed: 2

Check WAN and LAN MoCA Data Rates

Rx and Tx Data rates for both WAN and LAN MoCA retrieved through telnet

All Rates must be greater than threshold (e.g., 180 Mbps)

LAN Ethernet to WAN MoCA FTP Speed Test

From Eth LAN **1** to WAN MoCA

Iperf3 Speed Test, 5 seconds Reverse and Forward (e.g., Sending 1200 Mbps Bandwidth)

Bandwidth must be greater than threshold (e.g., 60 Mbps)

Total Retries allowed: 2

LAN MoCA to LAN Ethernet FTP Speed Test

From Eth LAN **1** to LAN MoCA

Iperf3 Speed Test, 5 seconds Reverse and Forward, (e.g., Sending 240 Mbps Bandwidth)

Bandwidth must be greater than threshold (e.g., 60 Mbps)

Total Retries allowed: 2

LAN MoCA to WAN MoCA FTP Speed Test

From LAN MoCA to WAN MoCA

Iperf3 Speed Test, 5 seconds Reverse and Forward, (e.g., Sending 240 Mbps Bandwidth)

Bandwidth must be greater than threshold (e.g., 60 Mbps)

Total Retries allowed: 2

Enable WAN Ethernet

Through telnet command

LAN Ethernet to WAN Ethernet FTP Speed Test

From Eth LAN **1** to Eth WAN

Iperf3 Speed Test, 5 seconds Reverse and Forward, (e.g., Sending 1200 Mbps Bandwidth)

Bandwidth must be greater than threshold (e.g., 700 Mbps)

Total Retries allowed: 2

Clear Persistent Logs

Final Factory Restore

According to certain embodiments, the core testing processor uses a reflection and command design pattern to invoke the relevant configured script(s) corresponding to each DUT being tested. For example, in the command design pattern one or more of the following are encapsulated in an object: an object, method name, arguments. According to certain embodiments, the core testing processor uses the Python "reflection" capability to execute the relevant test scripts for a given DUT. The core testing processor is agnostic of the inner workings of the relevant test scripts for a given DUT.

According to certain embodiments, lightweight software containers (virtualization containers) are used to abstract the connection of probes to the different DUT interfaces in order to avoid conflicts. Non-limiting examples of virtualization containers are Linux containers. As a non-limiting example, Linux container is an operating-system-level virtualization environment for running multiple isolated Linux systems (virtualization containers) on a single Linux control host. In other word, lightweight virtualization containers are used to ensure isolation across servers. By using virtualization containers, resources can be isolated, services restricted, and processes provisioned to have an almost completely private view of the operating system with their own process ID space, file system structure, and network interfaces. Multiple virtualization containers share the same kernel, but each virtualization container can be constrained to only use a defined amount of resources such as CPU, memory and I/O. The relevant test script connects to the DUT interfaces through the virtualization containers to execute the tests. The core testing processor receives the test results from running the relevant test scripts. The core testing processor can further process and interpret such results and can also send the results to the user's browser via web sockets. According to certain embodiments, the respective core testing processors are in communication (e.g., Telnet/SSH secure shell) with the virtualization containers (there may be multiple virtualization containers). The virtualization containers (probes) are in communication with corresponding DUT interfaces using Telnet/SSH/TCP/UDP/HTTP/HTTPS etc., as non-limiting examples.

According to certain embodiments, a system for testing a plurality of devices comprises: a universal tester; at least one test controller; a plurality of sets of testing probes; and a plurality of web sockets; wherein:

the plurality of devices includes a plurality of wireless router;

the universal tester is enabled for communication with a platform independent user interface through the plurality of web sockets;

the plurality of sets of testing probes comprising:

a plurality of LAN probes for testing corresponding LAN interfaces of a wireless router of the plurality of wireless routers;

at least one WLAN probe for testing a corresponding WLAN interface of the wireless router of the plurality of wireless routers;

at least one Ethernet WAN probe for testing a corresponding WAN interface of the wireless router of the plurality of wireless routers;

at least one MoCA LAN probe for testing a corresponding coax interface of the wireless router of the plurality of wireless routers;

at least one MoCA WAN probe for testing a corresponding coax interface of the wireless router of the plurality of wireless routers; and

the plurality of web sockets enable real-time bi-directional and asynchronous communication between the platform independent user interface and the universal tester for simultaneously testing the plurality of devices under test by the universal tester.

According to certain embodiments, the system for testing a plurality of devices further comprises a MoCA LAN bridge.

According to certain embodiments, the system for testing a plurality of devices further comprises a MoCA WAN bridge.

According to certain embodiments, the system for testing a plurality of devices further comprises a splitter.

According to certain embodiments, the real-time bi-directional and asynchronous communication of the plurality of web sockets enables a user to control the testing of the plurality of devices simultaneously but asynchronously and independently of each other using the universal tester.

According to certain embodiments, the plurality of devices installed in the universal tester for purposes of simultaneous testing comprise a set of disparate devices.

According to certain embodiments, the plurality of devices installed in the universal tester for purposes of simultaneous testing comprise a set of similar devices.

According to certain embodiments, the testing system is adaptable to augmenting the test controller, the plurality of web sockets, the user interface and the plurality of sets of testing probes to accommodate testing of new types of devices.

In the foregoing specification, embodiments of the invention have been described with reference to numerous specific details that may vary from implementation to implementation. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

We claim:

1. A universal tester for testing a plurality of wireless routers, comprising:

a plurality of test slots, each test slot of the plurality of test slots configured to host a wireless router of a plurality of wireless routers; and

a plurality of sets of test connections, each set of test connections of the plurality of sets of test connections being associated with one test slot of the plurality of test slots,

wherein each set of test connections of the plurality of sets of test connections comprises:

a wireless networking test connection configured to test a corresponding wireless networking interface on a wireless router of the plurality of wireless routers,

an Ethernet test connection configured to test a corresponding Ethernet interface on a wireless router of the plurality of wireless routers, and

a MoCA test connection configured to test a corresponding MoCA interface on a wireless router of the plurality of wireless routers.

2. The universal tester of claim **1**, wherein the plurality of test slots comprise faraday cages.

3. The universal tester of claim **1**, wherein the Ethernet test connection is configured to test a wide area network interface.

4. The universal tester of claim **1**, wherein the Ethernet test connection is configured to test a local area network interface.

5. The universal tester of claim **1**, wherein the MoCA test connection comprises a MoCA local area network test connection and a MoCA wide area network test connection configured to test a corresponding coax interface on a wireless router of the plurality of wireless routers.

6. The universal tester of claim **5**, further comprising a MoCA WAN bridge, a MoCA LAN bridge, and a splitter.

7. The universal tester of claim **1**, further comprising at least one web socket for communicating with a user interface, wherein the at least one web socket enables real-time, bidirectional, and asynchronous communication with the user interface.

8. The universal tester of claim **1**, wherein the universal tester is capable of simultaneously and independently testing the plurality of wireless routers.

9. The universal tester of claim **1**, wherein the test connections are associated with software virtualization containers.

10. The universal tester of claim **9**, wherein the software virtualization containers comprise Linux containers.

11. A method for testing a plurality of wireless routers, comprising:

associating a plurality of test slots with a plurality of wireless routers, each test slot of the plurality of test slots having a set of test connections to connect with a wireless router of the plurality of wireless routers; and

communicating between a user interface and the plurality of sets of test connections via a plurality of web sockets in a real-time, bidirectional, and asynchronous manner,

wherein each set of test connections

uses a wireless networking test connection to test a wireless networking interface on a wireless router of the plurality of wireless routers,

uses an Ethernet test connection to test an Ethernet interface on a wireless router of the plurality of wireless routers, and

uses a MoCA test connection to test a coax interface on a wireless router of the plurality of wireless routers.

12. The method for testing a plurality of wireless routers of claim **11**, wherein the plurality of test slots comprise faraday cages.

13. The method for testing a plurality of wireless routers of claim **11**, wherein the Ethernet test connection is configured to test a wide area network interface.

14. The method for testing a plurality of wireless routers of claim **11**, wherein the Ethernet test connection is configured to test a local area network interface.

15. The method for testing a plurality of wireless routers of claim **11**, wherein the MoCA test connection comprises a MoCA local area network test connection and a MoCA wide area network test connection configured to test a corresponding coax interface on a wireless router of the plurality of wireless routers.

16. The method for testing a plurality of wireless routers of claim **15**, further comprising a MoCA WAN bridge, a MoCA LAN bridge, and a splitter.

17. The method for testing a plurality of wireless routers of claim **11**, wherein the real-time, bidirectional, and asynchronous communication of the plurality of web sockets enables a user to control the testing of the plurality of wireless routers simultaneously but asynchronously and independently of each other.

18. The method for testing a plurality of wireless routers of claim **11**, wherein the test connections are associated with software virtualization containers.

19. The method for testing a plurality of wireless routers of claim **18**, wherein the software virtualization containers comprise Linux containers.

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